PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semester 2011

College of Sciences

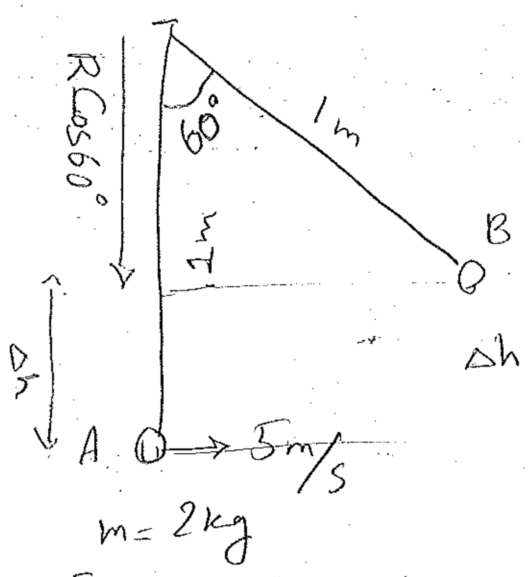
Section 1 Quiz 6 03 November 2011

**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 15 minutes**

**Name:** **Student ID:** **Signature:**

A 2 kg mass tied to the end of a 1m string swings as a pendulum in a vertical plane. At the lowest point in its swing, the speed of the mass is 5 m/s. What is the kinetic energy of the mass (in Joules) at the instant that the string makes an angle of 60° with the vertical? Take g=10 m/s$^2$. (Cos 60° = Sin 30° = 0.50 , Cos 30° = Sin 60° = 0.87).

$\Delta h = R - R\cos 60^\circ = 1(1-0.5) = 0.5$ m




$E_A = E_B$

$U_A + k_A = U_B + k_B$

$\frac{1}{2} m v_A^2 = mg\Delta h + \frac{1}{2} m v_B^2$

$k_B = \frac{1}{2} m v_B^2 = \frac{1}{2} \times 2 \times (5)^2 - 2 \times 10.0 \times 0.5 =$

$= 25 - 10 = 15\,J$

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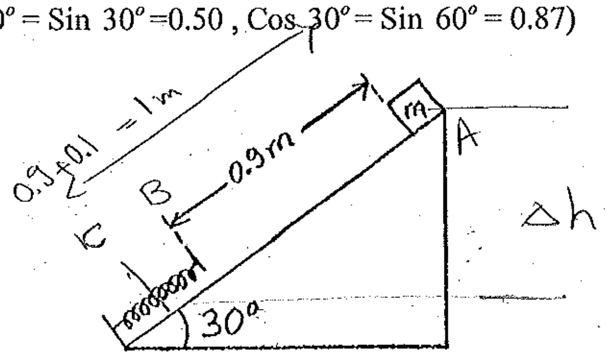
**Section 2** **Quiz 6** **03 November 2011**

**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 15 minutes**

**Name:** **Student ID:** **Signature:**

A block of mass m slides down (starting from rest) a frictionless plane 0.9 m long and compresses a spring of spring constant $10^4$ N/m by 10 cm. What is the weight of the block (in N)? (Cos $60^o$ = Sin $30^o$ = 0.50 , Cos $30^o$ = Sin $60^o$ = 0.87)




we know $\overline{AC} = 1m$

$\Delta h = 1m \times \sin 30 = 0.5\,m$

m is at rest

$V_A = V_C = 0$

conservation of energy for point A and C

$E_A = E_C \Rightarrow U_A + K_A = U_C + K_C$

$mg\Delta h + \frac{1}{2} m V_A^2 = \frac{1}{2} k x_{BC}^2 + \frac{1}{2} m V_C^2$

Potential Energy in spring

we know $x_{BC} = 0.1$ m. is the compressing of spring

$$mg = W = \frac{\frac{1}{2} \times 10^4 \times 0.01}{0.5} = 100\ N$$

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**Section 3** **Quiz 6** **03 November 2011**

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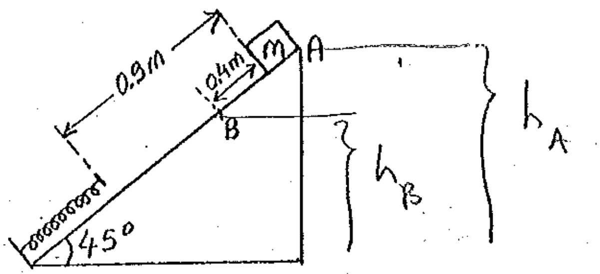
**Quiz duration: 15 minutes**

**Name:** **Student ID:** **Signature:**

A block of mass m at A at rest, slides down on an inclined plane and compresses the spring by 10 cm. It then moves up the plane and is found to stop at point B, 40 cm below its initial position. What is the coefficient of friction between plane and block? ($\cos 45^\circ = \sin 45^\circ = 0.7$)




$f_k = \mu_k n = mg\mu_k \cos 45^\circ$

total path from $A \rightarrow B = \Delta S = 1.6m$

$W_{friction}$ = Energy Dissipation in total path $= E_f - E_i$

$-f_k \Delta S = mgh_B - mgh_A = mg(h_B - h_A) = -mg\,0.4 \sin 45$

$\Rightarrow \Delta S\, mg\mu_k \cos 45 = 0.4\, mg \sin 45^\circ \rightarrow \mu_k = \frac{0.4}{1.6} = 0.25$

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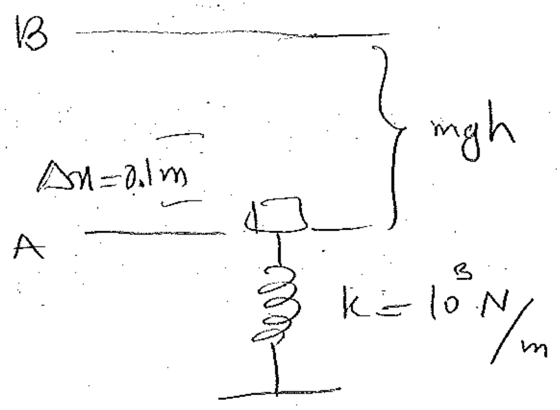
**Section 4** **Quiz 6** **03 November 2011**

**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 15 minutes**

**Name:** **Student ID:** **Signature:**

A 2 kg object is placed on a vertical spring of negligible mass and force constant k=1000 N/m that is compressed 10 cm. When the spring is released, how high the object rise from this initial position? (The object and the spring are not attached) Take $g=10\,m/s^2$.




$m = 2\,kg$

$$E_A = E_B$$

$$\frac{1}{2} k \Delta x^2 = mgh$$

$$h = \frac{\frac{1}{2} \times 10^3 \times 0.01}{2 \times 10} = \frac{1}{4}\,m = 25\,cm$$

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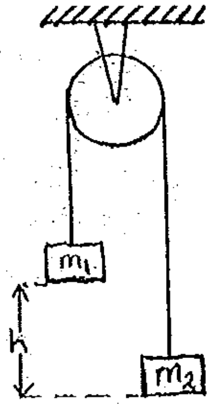
**Section 5 Quiz 6 03 November 2011**

**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 15 minutes**

**Name: Student ID: Signature:**

Mass $m_1$ is attached to a light string over a pulley and attached to another mass $m_2$ ($=m_1/2$). When the mass $m_1$ has fallen (starting from rest) a distance h, what is its speed? (Use energy conservation principle and ignore the friction and the mass of the pulley.)




Energy of system before falling = Energy of system after falling

$$E_i = E_f$$

$$U_{m1} + K_{m1} + U_{m2} + K_{m2} = U'_{m1} + K'_{m1} + U'_{m2} + K'_{m2}$$

$$m_1gh + 0 + 0 + 0 = 0 + \frac{1}{2}m_1v_1^2 + m_2gh + \frac{1}{2}m_2V_2^2$$

we know that speed of two masses is the same everywhere so $V_1^2 = V_2^2$ and using $m_2 = \frac{1}{2}m_1$ we have

$$m_1gh = \frac{1}{2}m_1V_1^2 + \frac{1}{2}\times\frac{1}{2}m_1V_1^2 + \frac{1}{2}m_1gh$$

$$\Rightarrow V_1 = \sqrt{\frac{\frac{1}{2}gh}{\frac{3}{4}}} = \boxed{\sqrt{\frac{2gh}{3}}}$$